The Management of Water Resources series

Series Editor: Charles W. Howe, Professor Emeritus of Economics and Professional Staff, Environment and Behavior Program, Institute of Behavioral Science, University of Colorado at Boulder, USA

Water resources today command broad regional, national and international attention. Water plays a crucial role in economic development, environmental management and the general quality of life in all parts of the world. International bodies are currently addressing pervasive water problems, including the policing of international rivers, the resolution of increasing conflict over limited supplies, the role of dams in water management, etc.

This series of five books summarizes the economics and management of water resources in five main areas: climate change and its potential impact on water systems; the role of water in economic development; the impact of irrigated agriculture on the environment; the economics of industrial water use; and conflict prevention and resolution in water systems.

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Conflict Prevention and Resolution in Water Systems

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This important collection reprints the most significant papers and case studies on the prevention and resolution of conflict over water resources. It focuses in particular on the human dynamics that are involved when conflicts over water resources impact on different interest groups, economic sectors and legal or political boundaries. It addresses key issues which arise at both the local and the international level, including amongst others: How do people interact in these situations of conflict? What methods do they use to find a compromise? What institutions do they create - either jointly or unilaterally - to help overcome problems in the future?

This interdisciplinary collection will be essential reading for professional water practitioners throughout the world, including engineers, economists, geographers, geologists, and political scientists concerned with water disputes and conflict resolution. It will make a significant contribution to the study of water as an essential theme in the increasingly important topic of environmental security.

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Introduction to Conflict Prevention and Resolution in Water System
By Aaron T. Wolf

The sage's transformation of the world arises from solving the problem of water. If water is united, the human heart will be corrected. If water is pure and clean, the heart of the people will readily be unified and desirous of cleanliness. Even when the citizenry's heart is changed, their conduct will not be depraved. So the sage's government does not consist of talking to people and persuading them, family by family. The pivot (of work) is water.
-Lao Tze

While disputes over water have taken place since time immemorial (think Isaac and the herdsman of Gerar [Genesis 26: 19-22]), as have efforts at dispute resolution (Hammurabi's code had some 300 sections devoted to water use and misuse), the field of "water conflict prevention and resolution" is neither clearly defined nor does it have its own "classic" literature.

For one, what is conflict? As US Supreme Court Justice Warren famously said (about another issue entirely), "I know it when I see it." But for precision's sake, we can use Frey's (1992) definition of, "[T]wo or more entities, one or more of which perceives a goal as being blocked by another entity, and power [of some sort] being exerted to overcome the perceived blockage." In this context, we are restricted neither by shots being fired, nor by the disputants being sovereign nations, but are looking instead at the human dynamics when water flows across any two sets of interests, economic sectors, or legal or political boundaries.

The next, more subtle, issue is, "what is conflict resolution?" Is it how people dialogue? The tools/disciplines they use to find compromise? The institutions they create, jointly or unilaterally? The answer which guides the approach to this collection is, simply, "yes." Who affects Whom?

In order to get at this latter set of questions, we first need to address the larger issues between people and their environment - who affects whom? In other words, it is quite clear that people affect their environment - the resources and natural systems which surround them - but to what

extent is the opposite true: just how deep is the causal relationship between environmental stresses and the structure of human politics? This relationship is at the heart of understanding the processes of environmental conflict prevention and resolution. If, as the large and growing "water wars" literature would have it (see, for example, Cooley 1984; Starr 1991; Bulloch and Darwish 1993 ; and Remans 1995), the greatest threat for water conflicts is that water scarcity can and will lead directly to warfare between nations, this lends itself to diversion of a potentially huge amount of resources, in attempts to arrest these processes at the highest levels. If the processes are actually both more subtle and more local in nature, then so too are the potential solutions.

While the extreme "water wars" literature is not included here (as a potential diversion of textual resources), a number of articles are included that argue quite persuasively for some degree of causality between environmental stress - reaching up against relative resource limits - and political decision-making. One cannot discuss water institutions, for example, without invoking Wittfogel (1956, reprinted as...) and his classic argument that the drive to manage water in semi-arid environments led both to the dawn of institutional civilization (described by Delli Priscoli (1998, reprinted as...) as the "training ground for civilization"), and to particularly autocratic, despotic forms of government. This latter argument, and the generally enthusiastic reception he received, needs to be understood in the Cold War setting from which it sprang, and was quite effectively challenged by Toynbee (1958), among others. Toynbee's vehemence in his review (he calls Wittfogel's book a "menace") is particularly interesting since many of Wittfogel's theories can be seen as extensions of a sort of Toynbee's "challenge-response" thesis (1946, reprinted as...), in which he argues that the impetus towards civilization becomes stronger with greater environmental stress. (Toynbee's objections are primarily with Wittfogel's "tribalistic" lens to history, aimed, as Toynbee charges, at demonizing the Soviet Union. Wittfogel (1958) in turn, distinguishing himself from Toynbee, writes of his own position, "causality yes, determinism no...")

This thread of causality between the environment and politics has been taken up regularly over the years. When Harold and Margaret Sprout (1957, reprinted as...) describe the environmental factors inherent in international politics, it becomes the direct intellectual precursor to today's blossoming "environmental security" literature, as spearheaded by Homer-Dixon (1991). Homer-Dixon, like Wittfogel, was initially greeted enthusiastically by the defense establishment, this time in the setting of the post-Cold War redefinition of the relevance of the military and, again like Wittfogel, has been taken to task for going too far in the degree of causality in his arguments. A summary of Homer-Dixon's findings (1996, reprinted as...), along with a debate on the topic is presented here (Homer-Dixon et al. 1996, reprinted as...) to give a flavor of the larger issues. In his defense, Homer-Dixon's arguments, along with those of much of the "water wars" crowd, have become more muted over the last few years: in 1994, he wrote: "the renewable resource most likely to stimulate interstate resource war is river water," which he repeats in his 1996 article, but here modifies the claim, elaborated in his 1999 book: "In reality, wars over river water between upstream and downstream neighbors are likely only in a narrow set of circumstances...[and]...there are, in fact very few river basins around the world where all these conditions hold now or might hold in the future."

Conflict and Cooperation

In water systems, the dichotomy of causality is manifested as whether water stress lends itself more readily to conflict or cooperation. Two sections are included here, each with an emphasis on one aspect or the other. Both arguments are powerful and are supported by a rich, if mostly anecdotal, history.

Postel (1999, reprinted as...) describes the roots of the problem at the sub-national level. Water, unlike other scarce, consumable resources, is used to fuel all facets of society, from biologies to economies to aesthetics and religious practice. As such, there is no such thing as managing water for a single purpose - all water management is multi-objective and is therefore, by definition, based on conflicting interests. Within a nation these interests include domestic users, agriculturalists, hydropower generators, recreators, and environmentalists - any two of which are regularly at odds, and the chances of finding mutually acceptable solutions drop exponentially as more actors are involved.

As described conceptually and with case studies by Trolldalen (1992, reprinted as...), these conflicting interests within a nation represent both a microcosm of the international setting, and a direct influence upon it. As Tip O'Neil might have said (had he had more hydrologic training), "all water management is local": the interests of nations are essentially the interests of its citizens (multiplied, of course, by the amount of power each is able to mobilize). Trolldalen's work is particularly useful in that he sidesteps the common trap of treating nations as homogeneous, rational entities, and explicitly links internal with external interests. Bangladesh is not just the national government of Bangladesh when it negotiates a treaty with India over Ganges flow, but it is its coastal population, inundated with saltwater intrusion; its farmers, dealing with decreasing quantities and increasing fluctuations; and its fishermen, competing for dwindling stocks.

This link between the internal and external is critical when we look at violent international conflicts. Gleick (1993, reprinted as...), is widely cited as providing what appears to be a history rich with violence over water resources. But a close read of his article reveals greater subtlety and depth to the argument. In my article (1998, reprinted as...), I point out that what Gleick and others have actually provided is a history rich with tensions, exacerbated relations, and conflicting interests over water, but not violence, at least not between nations or over water as a scarce resource. It is worth noting Gleick's careful categorization, because the violence he describes actually turns out to be water as a tool, target, or victim of warfare - not the cause. In my article, I contrast the results of a systematic search for interstate violence - one true water war in history, 4500 years ago, and seven cases of acute water-related violence - with the much richer record of explicit, legal cooperation - 3600 water-related treaties. In fact, a scan of the most vociferous enmities around the world reveals that almost all the sets of nations with the greatest degree of animosity between them, whether Arabs and Israelis, Indians and Pakistanis, or Kyrgis and Uzbeks either have a water-related agreement in place, or are in the process of negotiating one.

The causal argument, then, seems both more complex and more subtle in water systems than has been argued, affecting primarily issues of stability rather than violence, and tied intractably to the surrounding political setting. The real lessons of history turn out to be that, while water can act as an irritant, making good relations bad and bad relations worse, it rarely induces acute violence

and often acts as a catalyst to cooperation, even between bitter enemies. Moreover those institutions that are created turn out to be extremely resilient over time, even as conflicts rage over other issues (Wolf 1998, reprinted as...). What, then, does this knowledge suggest about the most productive path towards conflict prevention and resolution? Spector (2000, reprinted as...) offers detailed lessons for what has been termed "preventive diplomacy," a concept based on the premise that it is easier and cheaper to prevent disputes before they begin, than it is to resolve them after the fact. While seemingly self-evident, preventive diplomacy has proven difficult in practice, primarily because of the barriers within the international community of mobilizing crisis-level interest and resources before a crisis actually occurs. As Spector describes it, though, the concept is gaining momentum, particularly within the western defense establishment, and he offers cases for how it has been used effectively, as well as the processes of preventive negotiations for problem-solving.

Coming full circle from the local to the international and back to the local, Painter (1995, reprinted as...) and Clark et al (1991, reprinted as...) describe how the tools used by Alternative Dispute Resolution (ADR) - mediation, facilitation, and arbitration - can be effective in resolving environmental disputes, an application termed EDR (environmental dispute resolution). The rationale for ADR and EDR are similar to those of preventive diplomacy - ie. it is cheaper and the solutions are more robust when issues are resolved through dialog rather than litigation (or combat), and Clarke et al. offer settings and cases to back the argument up. Painter, a healthily skeptical advocate (and practitioner), offers a brief history of EDR from its roots in labor negotiations, suggests some problems with the approach, and concludes with "post-structural alternatives."

Cases and Institutions

The case studies of basin dynamics and institutions are fairly self-explanatory, and are organized in ascending order of complexity from the most local through greater numbers of riparian nations and increasing levels of animosity. The section concludes with two chapters on sets of transboundary waters which are regularly overlooked in much of the international community - aquifers (Krishna and Salman 1999, reprinted as...) and lakes (Dinar et al. 1995, reprinted as...).

In describing these actual examples of water disputes, processes of dispute resolution, and cooperative institutions, we move from the realm of what should be done to what has actually been accomplished, and the disparity can be quite jarring. Some might describe this gap between the prescriptive and the possible as one between western idealism, drawn from settings which are economically developed democracies and relatively conflict-free to, well, the bulk of the real world. And there may be some truth to that. Contrast, for example, Vaz and Perreira's (2000, reprinted as...) descriptions on the Incomati and the Limpopo, where even the most basic data are missing, joint management is in its relative infancy, and the geopolitics are overwhelmingly intricate, to Nachtanabel's (2000, reprinted as...) portrayal of the Danube, where an uninterrupted institutional history dates back to 1856, the riparians have led the world in the shifting emphasis from transportation concerns to quantity to quality, and the management emphasis has moved from hierarchical command and control to public participation.

Or note the wildly contrasting interpretations of even a common history, in the works of Soffer (1994, reprinted as...) and Mustafa (1994, reprinted as...), let alone of the most basic hydrologic data. These two articles appeared back to back in proceedings of the first international Israeli-Palestinian meeting on their shared waters, held in Zurich just as peace talks between the two sides commenced. Those who advocate objectivity, efficiency, and rationality in dispute resolution might do well to remember that, to paraphrase one scholar, "In some parts of the world, people just hate each other." Which flag flies over the pumping station can be wildly more important than the marginal cost of pumping the water. In the same breath, it should be noted that, in the relatively short time that has passed since talks began, Arabs and Israelis have made tremendous strides in resolving their water disputes, including a viable peace treaty between Israel and Jordan, and a declaration of principles, including water rights, between Israel and the Palestine Authority.

Besides the striking fact that all of the disputes described here have reached some level of resolution, one cannot help but notice just how similar some sets of problems facing parties locked in hydroconflict can be, regardless of the level of economic development or geographic scale involved. Acequia, for example, is the term used in the US's desert southwest and other Spanish-speaking parts of the world to denote both an irrigation ditch and the informal institution which manages it. In Crawford's (1988, reprinted as...) description of his period as mayordomo, or ditch manager of an acequia in New Mexico, he writes of two neighbors who: ". . . have never been on good terms, at least in my hearing, the lower neighbor commonly accusing the upper of never letting any water pass downstream to his place and then of dumping trash into it whenever he rarely does."

This is, in essence, the heart of water conflicts since forever. In modern days, the neighbor's complaint could be Syria's of Turkey, Pakistan's of India (see Biswas 1992, reprinted as...) or Egypt's of Ethiopia (see Whittington et al. 1995, reprinted as...). For all our 21st centuries capabilities in water management - whether in dynamic modeling, remote sensing, Geographic Information Systems, desalination, biotechnology, or demand management - and for all our new-found concerns with globalization, privatization, and information technologies, the crux of the disputes are still often about little more than who opens a diversion gate when, and how much garbage gets put into the water as it makes its way downstream.

This universality of water problems is embedded in the very terminology we use to describe them: acequias have their roots in Spain - according to tradition, the Tribunal de las Aguas (Water Court) has been meeting to resolve the disputes over the acequias around Valencia in the same church-front square since Medieval times, if not before (Glick 1970). But the root of acequia is al-saqia, Arabic for a gear-driven water wheel, the technology which made early irrigation possible along many of the rivers of the ancient Middle East (Oleson1984). From the Middle East to Spain to the New World - many of the problems remain.

The fortunate corollary, of course, is that so do many of the solutions, as exhibited in the sections on institutions. The fundamental question of water management institutions is: Who participates in decisionmaking, and on what basis are the decisions made? Again, we find a certain consistence across time and geographical scale, which gives us a vast solution set to draw from. The questions of management authority and participation which Attia (1985, reprinted as...)

encounters within an oasis community in Tunisia are essentially the same as those confronted at the international level by Agrawal and Gibson (1999, reprinted as...): Who allocates the resource? How much input should the "public" have, and at what levels? Ostrom (1992, reprinted as...) has done remarkable work in tying small-scale, local experiences in water management with larger lessons and scales. In work not included here (Wolf 2000), I investigate the allocation rules of Berbers and Bedouin, and draw implications from their experiences for international waters.

Another recurring institutional theme is the question of subsidiarity, which suggests that the most efficient management should be at the lowest level consistent with adequate accounting for externalities. Which, if one were to operationalize the principle, is where? Top down? Bottom up? Something in between? Recent environmental literature, as represented by Milich and Varady (1999), warmly advocate public participation as being more transparent, more democratic and, through a bit of a leap, as leading to greater environmental sustainability. Agrawal and Gibson (1999, reprinted as...) remind us that communities, like nations, are not homogeneous in their interests - that advocates are often describing "'mythic communities:' small, integrated groups using locally evolved norms to manage resources sustainably and equitably...[and] ignore how differences affect processes around conservation, the differential access of actors within communities to various channels of influence, and the possibility of 'layered alliances,' spanning multiple levels of politics."

Nakayama (1997, reprinted as...), in a comparative case study of four international basins, suggests that buy-in at the highest possible levels is one of the prerequisites for success in developing institutions across boundaries. While many of the advantages of participatory processes are self-evident, it must be remembered that, while it may fit well when the co-riparians have democratic roots and warm relations, in many cultural settings consulting with the public is seen as weakness - leaders who turn to the people must by definition be ineffectual. In other basins, data is viewed with military secrecy and tied to issues of national security. And all negotiation processes are susceptible to the truism that the more people in a room drafting a document, the less it says. Right or wrong, in many settings it can be presumptuous to argue the inherent supremacy of openness, transparency, capacity-building, and bottom-up design.

Turton (1999, reprinted as...) describes in his account of interaction between NGO's and nations in southern Africa one final limitation to participation across the borders of international basins - the extreme reluctance of nations to relinquish any degree of sovereignty to outside authority. Despite the tendency of water managers to think in terms of total integration of watersheds, even friendly states often have difficulty relinquishing sovereignty to a supra-legal authority, and the obstacles only increase along with the level of suspicion and rancor. At best in some settings, one might strive not for integration, but rather for coordination. Once the appropriate benefits are negotiated, it then becomes an issue of "simply" agreeing on a set quantity, quality, and timing of the water that will cross each border. Coordination, when designed correctly, can offer the same benefits as integration and be far superior to unilateral development, but does not threaten the one issue all nations hold dear - their very sovereignty.

Disciplines and Worldviews

Water is a powerfully unifying resource, so it is ironic to the point of absurdity that water education, management, and discourse is so fragmented. To truly learn about water in its most holistic sense, one needs to understand the many aspects of the hydrologic cycle, from meteorology to surface hydrology to soil sciences to groundwater to limnology to aquatic ecosystems. And that is just the physical cycle. One should also have an integral sense of the human dimensions, from economics to law to ethics to aesthetics to sociology and anthropology. Universities and management institutions are simply not organized along these lines; often they are fragmented to where even surface water and groundwater, quality and quantity, are separated out as if they were not inextricably inter-related. (Of course we in geography call this holistic approach - geography.)

Yet each of these disciplines offers its particular perspective on conflict prevention and resolution, and it is worth surveying several for their insight. While each discipline is rooted in its own typologies and terminologies, there are again surprising similarities from discipline to discipline, particularly in that each strives to provide a more structured framework to the often chaotic processes of conflict resolution: law (Bennett and Howe 1998, reprinted as...; Wescoat 1996, reprinted as...; and McCaffrey 1999, reprinted as...) through its clear delineation of the terms, boundaries, and solutions; economics and game theory (Howe et al. 1986, reprinted as...; and Rogers 1993, reprinted as...) through the unifying concepts of rationality and efficiency; engineering (Lancaster 1990, reprinted as...; and Bleed 1990, reprinted as...) by its depiction of present and future states, and how to get from one to the other; and political economy (Just et al. 1998, reprinted as...; and Allan 1998, reprinted as...) through its position at the intersect between political and economic decision-making.

Along the way, each discipline brings its distinctive set of tools to help the parties prevent disputes, resolve disputes, or visualize the problem in new ways to facilitate either prevention or resolution. Howe et al. (1986, reprinted as...) offers ways in which market mechanisms can help with the problem of water allocations; Rogers (1993, reprinted as...) describes through game theory how benefits might be equitably allocated across international boundaries; and Allan (1998, reprinted as...) offers his useful and adroitly named concept of "virtual water," the water that moves between consumers and across nations embedded within the products it was used to produce, as an argument against the limiting concept of water security. Of course, geography is represented by Gilbert White (1974, reprinted as...) who shows in this relatively less-known article both geography's capabilities in interdisciplinary analysis, and White's own prescience as he looks to the coming information age and its effects on systems analysis, risk assessment, and societal responses. Finally, Simonovic (1996, reprinted as...) brings the technology of the 21st century to bear on the issues, describing how new modeling tools, visualization techniques, and information technologies can be packaged as Decision Support Systems to aid parties in dispute in their decision-making.

Given that our training and management has lost sight of the unifying forces of water, it is of great credit to these scholars that their visions are as broad-based and interdisciplinary as they are. One manifestation of their inherently holistic thinking is that they have often chosen to describe the tools or paradigms of disciplines other than those of their initial training. Bennett and Howe, economists, and Wescoat, a geographer, assess the viability of various forms of legal

documents; Lancaster, a lawyer, takes on engineering; and Allan, a geographer, reworks basic assumptions in economics.

The Voice of the River

The collection ends with two chapters on behalf of the one party in these conflicts which, despite its centrality, has no voice whatsoever in the outcome of the resolution process - the river itself. It feels both counterintuitive and precarious that we can let water conflicts drag on to the extent they often do - the Indus treaty took ten years of negotiations, the Ganges thirty, and the Jordan forty - while all the while water quality and quantity degrades to where the health of dependent populations and ecosystems are damaged or destroyed. A re-read through the case studies offered here suggests that the simple fact that humans suffer and die in the absence of agreement apparently offers little in the way of incentive to cooperate, even less so the health of aquatic ecosystems. This problem gets worse as the dispute gains in intensity; one rarely hears talk about the ecosystems of the lower Nile, the lower Jordan, or the tributaries of the Aral Sea - they have effectively been written off to the vagaries of human intractability. Kolars (2000, reprinted as...), in his essay on the Tigris-Euphrates, arguably one of the most hotly contested basins in the world, reminds us that, even in such a tense setting, the river is more than a static conveyor of an economic resource, but is rather, "...a pulsing, cleansing system which serves the body regional as does a healthy circulatory system cleanse the human body," and should be treated as such in joint negotiations and management."

The last word, however, belongs to Sandra Postel (1992, reprinted as...), one of the river's most ardent and eloquent advocates. In her concluding chapter to Last Oasis, Postel argues that a water ethic, based on Aldo Leopold's land ethic, be incorporated into our thinking and planning, "simply" because it is the right thing to do: "Grasping the connection between our own destiny and that of the water world around us is integral to the challenge of meeting human needs while protecting the ecological functions that all life depends on... Water is the basis of life, and our stewardship of it will determine not only the quality but the staying power of human societies" (pp. 184, 185).

In 1985, on the 40th anniversary of the atomic bombing of Hiroshima and Nagasaki, Alvin Weinberg, who was involved in the development of the bomb and was later the director of Oak Ridge National Laboratory, wrote an editorial in the Bulletin of Atomic Scientists in which he argued that the taboo on using nuclear weapons has reached, and should continue to be considered, the same level of importance as a religious injunction - a commandment from on high, if you will, to refrain from what is effectively a form of self destruction no matter how it is done. Certainly we might recognize the same simple truth about our water resources - we hurt them, we hurt ourselves - and instill Postel's water ethic into our social, political, and, yes, religious, fabric.

One note: Narrowing this collection to a manageable size has been a task of inordinate difficulty (as the kind editors at Elgar will attest). Also, excerpts of books often include references to other chapters not included here. Much robust, relevant literature has been excluded, simply on the basis of space. The works of, Kliot et al. (1997), Elhance (1999), Milich and Varady (1999), Gleick (2000), Ohllson (2000), and Wouters (2000), for example, are excellent recent sources,

which the interested reader would do well to look up. The extensive annotated bibliography from Beach et al. exists on the Web, and is searchable by author, topic, or basin. Fortunately, an exceedingly rich literature is captured within the bibliographies of the chapters which are here, and the reader so inclined is strongly urged to follow those leads.

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